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Guest editorial

… to see or not to see …

At a recent SPIE meeting (Human Vision and Electronic Imaging) Maarten Wijntjes (see http://www.maartenwijntjes.nl/site/Main.html) informally joined me at my tabletop at the demo-session. Maarten had brought a synopter according to Moritz von Rohr's (König 1940; Zeiss and von Rohr 1907) mirror design.[1] He was interested in reactions.

One eye looks through a large semisilvered mirror, the other by way of a small full mirror and the reflection of the semisilvered one (figure 1). This places the latter eye *behind*, instead of *besides*, the former one. As a result, one (approximately) gets rid of binocular disparity for viewing distances over about four feet. The novelty of our device is that it uses plastic mirrors instead of the heavy glass ones. This allows for a cardboard folding design that could be mass produced for a trifle.

The demo-session was dominated by hi-tech guys in suits, intent on pushing their binocular stereo displays. The driving force was business, not science. Some suits had $$ signs in their eyes. What really interested me—a mere retired professor in casual attire—was the reaction of visitors to our device.

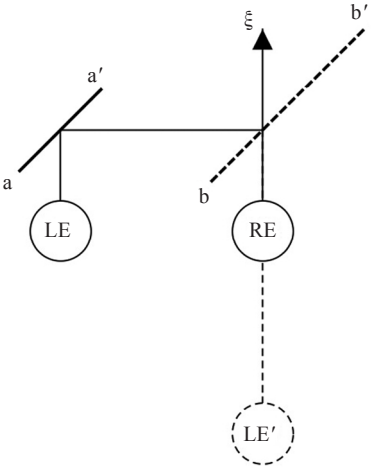

Figure 1. The mirror synopter due to Moritz von Rohr, only partially to scale. The mirror aa′ is fully reflective, whereas the mirror bb′ is semisilvered. Thus the left eye (LE) looks by way of both mirrors in reflective mode, whereas the right eye (RE) looks through mirror bb′ in transparent mode, both into the same direction ξ. The virtual position of the left eye (LE′) is *behind* the right eye. For distant objects there will be a minor scale difference between the left and right retinal images (this scale difference becomes vanishingly small for distant objects), but the disparity due to scene structure is much reduced. Lack of disparity implies that visual awareness is due to pictorial cues. Indeed, pictures appear in articulate 'relief' when viewed this way, the main selling point of Zeiss. It has to be experienced to be appreciated. The effect is psychical, rather than physical, belonging to *psycho-optics*, not optics proper. There is no way you may sensibly stamp a 'depth magnification—number' on the frame! In the photograph you see the semitranparent mirror next to the nose of Andrea van Doorn.

[1] A modern version of the synopter developed by Rob Black is described at http://3dguy.tv/new-prototype-glasses-turn-2d-into-3d-without-electronic-help/

Maarten had set up a nice picture display that could be viewed with and without the synopter. What we experienced was a much deeper pictorial space with the device as compared with natural viewing. A picture looks already much more 'spatial' when you close one eye ('paradoxical monocular stereopsis') (Schlosberg 1941), but synoptic viewing often heightens this experience. The effect is idiosyncratic. For me it is strong, for some much less so. We quantified it years ago (Koenderink et al 2001). We were interested in reactions from the public. I collected generic responses.

By far the most common response is this: "what do you want me to see?" The only appropriate answer is noncommittal, because the person is to *look and see*. Next, the person picks up the device and feigns to look. They most likely believe to look themselves. Looking is not something they're used to, true of many people. They evidently don't notice anything special, the most articulate remark being "oh". They walk on without interaction. I think: "are these guys interested in vision at all?"

Another common case: the person picks up the device, looks, and says "hey, great depth!", then continues "where do you get the disparity, isn't this just a single picture?" We: "yes, that is the idea". The person looks again and says "okay, so it's flat after all", and leaves. Some take a quick look to make sure the device is indeed a Rube Goldberg contraption, uneasy that they ever fell for the hoax.[(2)] Nobody remembers Harold Schlosberg (1941). In a blue mood I reflect that the regresses pretty much balance the progresses of science.

About one in twenty *looks*, and *looks again*, with and without the device. Some admit to "get an effect(!)". They demand an explanation. In one or two cases out of many we actually contracted some genuine interest, but most of the time we were being lectured, free of charge.

This experience is typical. Many people 'in vision' are blind, and 'see' only their beliefs. Good or bad? Hard to say. Stubborn hard-headedness has its virtues. Anyway, the incident induced me to write this editorial.

When I started in psychophysics (the mid-1960s) professionals were proud of their ability to *see*. I was told a few years might do it for me. This is similar to what you hear from many artists. Most projects involved only a *few experienced* observers, usually the authors. The paper described what the observers actually *experienced*. Such outdated papers are about perceptual awareness. For me—then as now—that is what vision is about.

Within a decade, the scene had completely changed. In the heydays of cognitive science you had papers accepted only where *none* of the authors was an observer, and where *all* observers (the more the better, and 'subject' is perhaps more descriptive than 'observer') were guaranteed to be entirely clueless as to what they were 'supposed to see'. Naive is the technical term. 'Forced choice' paradigms became fashionable. I have been a subject in experiments where I hadn't the faintest idea what I was reacting too. Yet I apparently made the experimenter happy! In the best of worlds even the experimenter was supposed to be clueless as to the visual awareness of the subjects. That would be the 'double blind' holy grail. All this was supposed to optimize the 'objectivity' of the study. Moreover, 'visual awareness' was supposed to be a mere epiphenomenon, there being no particular need to report upon it. In fact, doing so would decrease the probability of acceptance of a paper. I vividly remember how 'phenomenology' was considered antiquated and obsolete when I entered a psychology lab (coming from physics) in the early 1970s. *Real* scientists don't suffer from awareness at all; they are concerned with only *facts*. Few people spotted the self-contradictory nature of this silly concept.

Somewhere in the late 1980s a famous colleague visited us; because observations reported by us *had* to be wrong, we were *deluded*. Since he towered above us, this scared us a bit.

[(2)] Rube Goldberg (1883–1970) was an American cartoonist and inventor: see http://en.wikipedia.org/wiki/Rube_Goldberg_machine

We did prepare a demo that should turn him round. Throwing a glance at the display, he said "I see it, but I don't believe it." I was flabbergasted. My visual awareness is simply *given*. It is not a matter of right or wrong, it is *my reality*. I am ready to discuss possible causes of the awareness, but I am unable to ignore awareness itself. When others convince me that I see the world as it is not, I stubbornly *see what I see*. There is nothing I can do about that; nor—I think – can anyone else. I'm surely wrong there?

Never getting used to this, I was relieved when the atmosphere mellowed towards the end of my career [the 65 age limit, inspired by Otto von Bismarck's social reform of the 1880s, when few workers lasted that long (Busch 1898)]. Recently, friends shared an experience with me: it happens that subjects—when inserted in a luminous environment with their eyes held open—spontaneously report that they "see" things. Perhaps even more remarkable, it sometimes seems to matter to them what such experiences *are like*, as distinct from the optical influences on their overt behavior.

People mistrust visual (or *any*) awareness because different persons routinely report *different* awarenesses in front of a single scene. This never bothered me, since I don't take others for identical clones. Science has dealt with this in various ways. The standard procedure is to average over observers. Not unlikely, though rarely recorded, 'outliers' were probably discarded. In my view this has led to many unfortunate, misleading 'facts'. It seems reasonable to accept variations, and use these to get a handle on a problem. As nature provides you with parameter variations, why not use them? The alternative is to follow the military prescription techniques for helmet and combat boot sizes, and define another *International Standard Observer*. As an additional bonus, this does away with the need to bother with actual people. It is an 'industrial strength' solution.

Such differences become a real problem when the *qualities* of awareness (Albertazzi 2007, 2012) are important factors in the experiment. This happens in 'experimental phenomenology'. We recently reported on 'shape from shading'. We used the generic stimulus that has been the bread and butter in this topic since the 17th century (Koenderink and van Doorn 2003), a circular area filled with a linear luminance gradient in a uniform surround (figure 2).

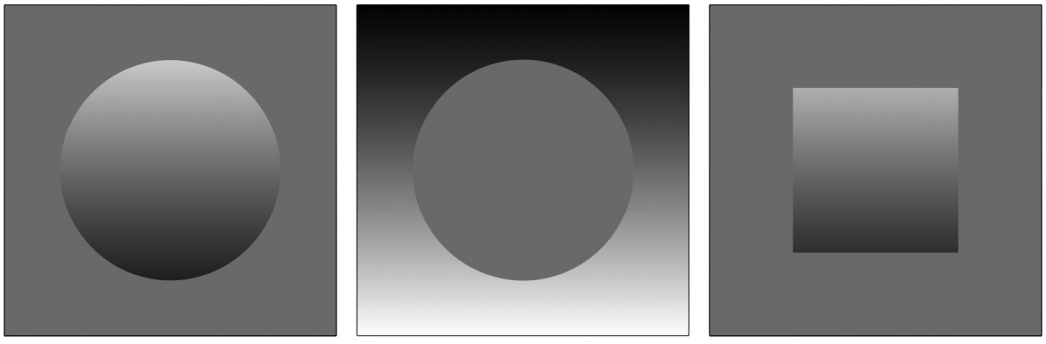

Figure 2. The figure at left is the 'generic stimulus' of shape from shading (SFS) research. Some remarkably objective observers report to be aware of a certain planar distribution of gray levels (the 'veridical perception'). The majority of observers are somehow aware of an illusionary, articulated surface. Most report a spherical convexity, some a spherical concavity. SFS theory predicts a quadric, thus admitting saddle shapes or cylinders. The disk at center is uniform, thus SFS predicts planarity, whereas many observers report a convex spherical cap. The central gradient at right is identical to that at left, except the square outline differs from the spherical one. Here most observers report cylindrical shapes. This is not predicted by SFS. In such ambiguous cases it would make sense for immediate awareness to be multivalued (Koenderink 2001). Cognition might then collapse the awareness on a unique perception, according to current situational awareness and goals. Such problems can be studied only in settings where experimental phenomenology is one of the approaches. Truly 'objective' methods never meet with any problem. Neither do they help solve many questions.

Most people become aware of a 'pictorial relief', sometimes convex, sometimes concave. Our observers reported "cup" or "cap", and thought of that task as "natural". One reviewer *never* experiences this, and seriously doubts anyone else does. He is aware of gradients of gray tone of some particular orientation. This led to fruitless interchanges. We knew (admittedly, we participated ourselves) that our observers reported "cap" or "cup" because that was in their immediate, momentary awareness. They could see the gradient as well, but only in a particular visual mode that involved somewhat of an intellectual effort.

Of course, we accept that the reviewer reported *his* immediate visual awareness. We also agree that the gradients are projected upon the retina. But we would disagree that the latter fact implies that observers cannot be aware of pictorial reliefs *directly*. Taken to the extreme, such an attitude would imply that all one may be aware of are spatiotemporal patterns of retinal photon absorptions. Maybe this applies to all others, except me? Possibly yes.

The matter reduces to a philosophical debate that is undecidable. This leads up to the question "is experimental phenomenology a science at all?" From my sampling at conferences, the main stream opinion is NO! So why not get rid of experimental psychology altogether, and simply distinguish between invasive and noninvasive physiology? Or consider 'human ethology' (Lorenz 1973; Tinbergen 1951), and study human perceptually guided (or triggered) behavior like a biologist would study the electric sense in sharks (Kalmijn 1971). We'll never know what it is like to have the whole body sensitive to electric fields (does it itch?), but we may very well study how it affects a shark's behavior.

My own perspective is different. Physiology leaves me with questions. Remember Nagel's (1974) great paper "What is it like to be a bat?" Physiology offers no clue on what it might be to be a bat or to be a human. Or to be yourself. "What is it like to be me"—better, "what is it like to be aware", are questions several people I asked thought relevant. Experimental phenomenology deals with such questions; physiology cannot.

Conclusions from experimental phenomenology are not formal systems that allow you to predict potential pointer readings from actual pointer readings (Eddington 1928). An important class of conclusions may be denoted 'visual proofs'. These are aspects of visual awareness that the large majority of visual observers will spontaneously 'have' when placed in specific, carefully prepared situations. Examples are the Gestalt phenomena (von Ehrenfels 1890), many familiar 'illusions', and so forth. Of course, such silent agreement would never occur between a human and a bat, or a shark. It is a human–human type of thing, involving species-wide empathy.

Visual proofs are not logical propositions. Logical propositions are by definition fully meaningless, and about nothing in particular. In contradistinction, visual proofs are meaningful and 'about' something (the *qualities* of awareness). Visual proofs yield immediate, intuitive insights for which the matter of truth or falsehood does never occur. *They are your reality*. Even your cherished 'physical reality' is derivative of *that*.

Visual proofs are suspect in science, but they are actually used all over the place—in physics, and even in mathematics. You encounter them at the rock bottom of proofs. A 'proof' deploys formal, logical procedures to force a reduction to 'known cases'. Known cases don't require proof. People nod in recognition when they meet them. Sometimes an *immediate* proof may be sufficient. Many of the Gestalt 'instant psychophysics' demos are examples. In mathematics I mention the visual proofs of the Pythagorean theorem, in physics the famous "Clootcrans bewijs" (Stevin 1586, figure 3). Instant proofs are the bread and butter of heuristics (Pólya 1957). People no less than Einstein depended on them.

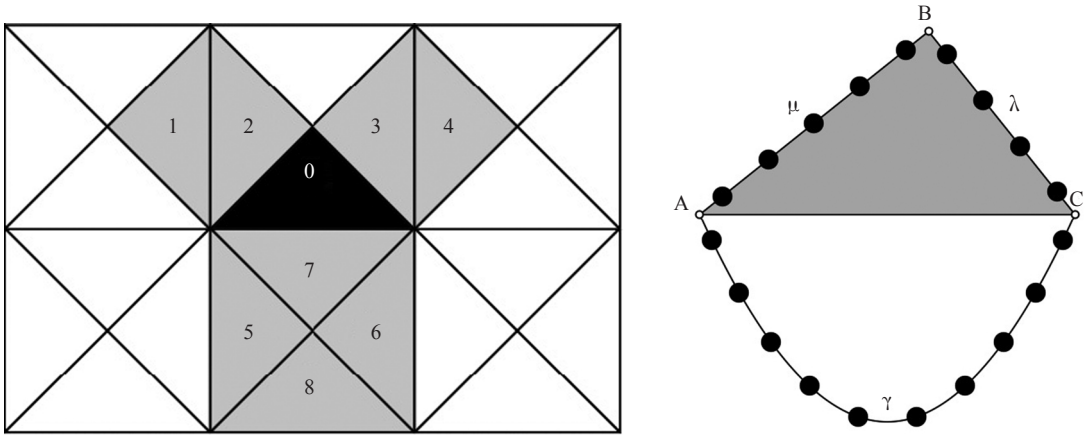

Figure 3. (a) A 'visual proof' of a special case of the Pythagorean theorem. Hundreds of alternative (general) visual proofs are known (http://www.cut-the-knot.org/pythagoras/index.shtml has 98 proofs of the Pythagorean theorem—webmaster Alexander Bogomolny), some millennia old. The (immediate) visual conclusion is '4 = 4' (total area of triangles {1, 2} and {3, 4} equals that of {5, 6, 7, 8}). If you are reduced to counting squares, you are stuck with '$2 \neq 1$' (the two squares {1, 2} and {3, 4} are different from the single square {5, 6, 7, 8}). Seeing these involves receptivity to invariances with respect to certain translations, rotations, or reflections. A full investigation of a case like this involves at least an academic career. (b) The *Clootcrans bewijs* (16th-century Dutch meaning "string of beads proof") by Simon Stevin. It is on a par with Newton's bucket of water on the twisted rope (Newton's bucket argument appears in a General Scholium at the beginning of *The Mathematical Principles of Natural Philosophy*, 1687), or Einstein's (1954) elevator. The beads (*cloten*) on the string μλγ (*crans*) hanging over the pulleys A, B, C are in equilibrium, as one would otherwise have a perpetual motion (*de cloten sullen uyt haer selven een eeuwich roersel maken, t'welck valsch is*). The beads on the lower part of the string γ pull equally on both sides, and thus are irrelevant. Thus the 5 beads on part μ apparently balance the 4 beads on part λ. This is a visual proof of the vector addition of forces. Stevin remarks "*Wonder en is gheen wonder*" (meaning "miracle is no miracle"), apparently amazed at the force of his visual proof. Physics works in much the same way; it is only that the people involved are intuitively connected to universes (differential geometry, and so forth) that are remote to most of us. But everybody should be sensitive to the vertebrate 'core systems' described by Elisabeth Spelke (Spelke and Lee 2012) and Giorgio Vallortigara (2010), the difference being in only degree.

Conclusion? I don't care whether experimental phenomenology 'is' a science or not, as long as it is an activity that I find interesting. People who ask me "What do you want me to see?" I'll politely dismiss. "To see or not to see, ay there's the point".[(3)]

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[(3)] Anonymous, 2013, http://internetshakespeare.uvic.ca/Library/SLT/literature/publishing/texts+1.html

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